Online Conductivity Measurement

Measuring · Monitoring · Controlling

Conductivity is a well recognized, and sometimes indispensable, parameter of state-of-the-art water, wastewater and industrial process analysis. Continuous measuring systems are employed to monitor the salt load at the influent of wastewater treatment plants, to control quality of drinking water and ultra-pure water or to determine non-specific contaminants in industrial processes.

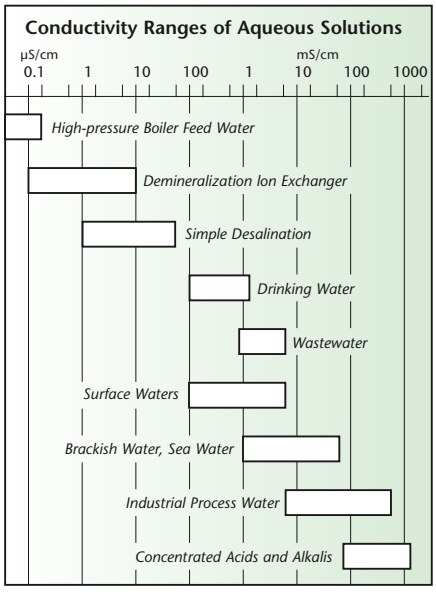
On-line Conductivity Measurements

- Municipal and Industrial Wastewater
- Water Treatment
- Surface Waters
- Sea Water, Brackish Water, Fishfarming
- Boiler Feed Water
- Demineralization
- Industrial Process Media

For more than 60 years, WTW has been one of the leading manufacturers of precision conductivity measurement systems, setting new standards with innovative sensor technology and fully evolved designs tailored to practical applications. WTW products meet the most stringent requirements set by industry for continuous on-line analysis instruments.

A special measuring transducer as well as sensors and accessories are available for use in explosion-proof areas (see brochure “Product Details”).

Conductivity

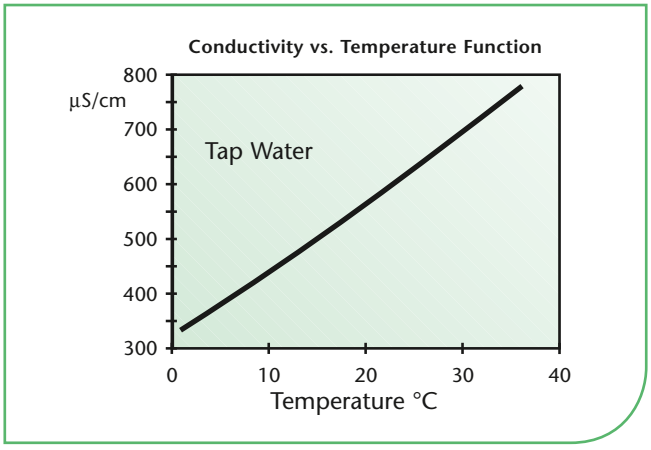


Conductivity as a summation parameter is a measure of the level of ion concentration of a solution. The more salts, acids or bases are dissociated, the greater the conductivity of the solution. In water or wastewater it is mainly a matter of the ions of dissolved salts, and consequently the conductivity is an index of the salt load in wastewater or, respectively, the purity of potable water. The measurement of conductivity is also widely used in industrial production, such as process control in food and pharmaceutical industries.

The measurement of conductivity is generally expressed in S/cm (or mS/cm) which is the product of the conductance of the test solution and the geometric factor of the measuring cell. The scale for aqueous solutions starts at a conductivity of 0.05 µS/cm (at 77 °F/25 °C) for ultrapure water. The conductivity of natural waters, such as drinking water or surface water is typically in range of 100 - 1000 µS/cm. The upper End of the scale is reached by some acids and alkalis.

Temperature Compensation

The conductivity of a solution is critically dependent on temperature. Therefore, the conductivity readings must be referred to a common reference temperature (77 °F/25°C) for comparability. The term “temperature compensation” is used in the sense of a mathematical conversion; i.e. a measured conductivity $\varkappa$ (ϑ) at any given temperature to the corresponding conductivity value that would be taken at the reference temperature $\varkappa$ (77 °F/25 °C).



The conductivity of most aqueous solutions varies more or less linearly with temperature ϑ. In these cases, a linear correction function to compensate for the influence of temperature can be used. For example, the correction coefficient for sewage is approx. 2%/K.

WTW monitors automatically calculate the corrected conductivity values based on the selected temperature coefficient. For the compensation of natural water a non-linear function (nLF) (i.e., built-in table for natural water properties) is available.

TetraCon® Conductivity Cells

TetraCon® 700/700 IQ

- 4-electrode Design
- Extremely robust and durable
- Large measuring range with only a single cell
- Highly resistant to fouling

TetraCon® 700 IQ

Compared to the 2-electrode sensors, the TetraCon® 4-electrode measuring procedure offers considerable application targeted advantages, especially in the area of higher conductivities.

TetraCon® 700 conductivity sensors are especially suitable for use in wastewater treatment plants dealing with highly loaded sewage. Due to the special measuring technique employed, severe influences from polarization effects are eliminated, resulting in improved accuracy of the sensor. Provided the devices are installed in accordance with the manufacturer's instructions, errors due to the distortion of the current and voltage fields are also avoided.

The special cell geometry of the TetraCon® 700 makes it impervious to fouling, and the abrasion resistant carbon electrodes are also easy to clean. The modern epoxy resin encapsulation technique used diminishes the likelihood of sensor breakage in harsh industrial environments.

The TetraCon® 700 as digital model TetraCon® 700 IQ is also available for connection to IQ SENSOR NET. This version is specially featured by a larger measuring range (10 µS/cm … 500 mS/cm).

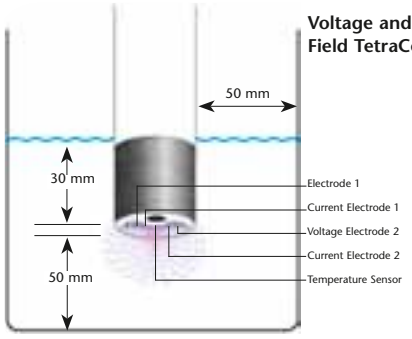
Furthermore, TetraCon® 700 SW seawater model for fish-farming has proven quality for harsh weather conditions, in salt water and with wave action.

TetraCon® 4-electrode Design

The conductivity of a given electrolyte is determined by an electro-chemical resistance measurement. In its simplest configuration, the measuring cell uses two electrodes to which an alternating voltage is applied. The electric current which is directly proportional to the free ions in the electrolyte is measured. The electronic instrument then calculates the conductivity of the solution, taking into account the absolute cell constant of the sensor.

With the TetraCon® 4-electrode design, two separate electrode pairs are used whereby the currentless voltage electrodes produce a stable and constant reference potential. The voltage drop at the current electrodes is regulated via a potentiostat circuit.

The advantage of this technique is that it eliminates measurement errors usually caused by polarization effects which most likely build up at higher conductivity levels. Contact resistance problems caused by contaminated electrodes is also largely avoided by this design.



Minimal Distance: 1.97 in. (50 mm)
Minimal Immersion Depth: 1.18 in. (30 mm)

WTW Conductivity Sensors

TetraCon® 700

Rugged conductivity sensor (4-electrode design), with integrated dual thermistor, abrasion resistant carbon electrodes and break-proof epoxy body; measuring range 10 µS/cm to 1000 mS/cm.
Submersible sensor assembly specially designed for use in wastewater treatment plants.

TetraCon® 325

4-electrode conductivity cell with graphite electrodes, integral temperature probe; measuring range 1 µS/cm - 2000 mS/cm. Suitable for universal applications.

TetraCon® DU/T

4-electrode conductivity cell with integral flow-thru chamber (7 ml volume), built-in temperature sensor; measuring range 1 µS/cm to 2000 mS/cm. Recommended for standard industrial applications.

TetraCon® 700 IQ

Digital 4-electrode conductivity cell (same as TetraCon® 700). In addition to the general preferences of IQ technology the TetraCon® 700 IQ offers the benefit of a larger measuring range (10 µS/cm … 500 mS/cm).

LRD 01

316 Ti stainless steel conductivity cell for installation in pipes. Built-in temperature sensor (266 °F/130 °C max.), measuring range 0.01 to 200 µS/cm, pressure resistant up to 14 bar, 1/2 inch NPT thread.

LRD 325

Conductivity measuring cell for installation in pipes. With built-in temperature sensor (up to 212 °F/100 °C).
Measuring range 1 µS/cm to 2 S/cm, pressure resistant up to 10 bar. 1/2 inch NPT thread.

LR 325/01

Low-level conductivity cell with flow-thru chamber, integrated temperature sensor; measuring range 0.001 to 300 µS/cm. For use in ultra-pure water applications; e.g., boiler feed water.

LR 325/001

Like Model LRD 325/01, but with higher resolution; measuring range 0.0001 to 30 µS/cm. Sensor is especially designed for trace measurement in both aqueous and non-aqueous or partially aqueous media.

Technical Data Conductivity Cells

Model	Digital	Analog		
	TetraCon® 700 IQ (SW)**	**TetraCon® 700 (SW**)**	**LRD 01**	**LRD 325**
Sensor Type	4-electrode cell	4-electrode cell	2-electrode cell	4-electrode cell
Measuring Range	10 µS/cm - 500 mS/cm SAL: 0 … 70 TDS: 0 … 2000 mg/l	10 µS/cm ... 1000 mS/cm * SAL: 0 … 70	0.001 ... 200 µS/cm	1 µS/cm ... 2 S/cm
Cell Constants	K=0.917 cm^{-1}, ±1.5% (in free solution) K=0.933 cm-1, with EBST 700- DU/N flow-thru adapter	K=0.917 cm^{-1}, ±1.5% (in free solution) K=0.933 cm^{-1}, with EBST 700- DU/N flow-thru adapter	0.1 cm^{-1}, ±2%	0.475 cm^{-1}, ±1.5%
Signal Output	Digital	Analog	Analog	Analog
Power Consumption	0.2 Watt	—	—	—
Temperature Sensor	Integrated NTC	Integrated NTC	Integrated NTC	Integrated NTC
Temp. Measuring	23 … 140 °F (-5 … +60 °C)	32 … 122 °F (0 … +50 °C), ±0.2 K	32 … 266 °F (0 … +130 °C), ±0.2 K	32 … 212 °F (0 … +100 °C), ±0.2 K
Maximum Pressure	10 bar	10 bar (at 68 °F / 20 °C)	14 bar (at 68 °F / 20 °C)	10 bar (at 68 °F / 20 °C)
Electrical Connections	2-wire shielded cable with quick fastener to sensor	Integrated PU connection cable with fitted 7-pole screw connector (IP 65)		
Certifications	CE, cETL, ETL	CE		
Mechanical	Sensor head: PVC Body: 316 Ti stainless steel Protection rating IP 68	Sensor head: PVC Body: 316 Ti stainless steel Protection rating: IP 68	Cell body: 316 Ti stainless steel Threaded 1/2 inch NPT Isolator material: PEEK Protection rating/Electrode: IP 68	Measuring cell: Epoxy / Graphit Thread: 316 Ti stainless steel Protection rating/Electrode head: IP 68
Dimensions (length x diameter)	14.06 x 1.57 in. (357 x 40 mm, incl. connection thread of SACIQ sensor connection cable) SW: 14.06 x 2.34 in. (357 x 59,5 mm)	7.72 x 1.57 in. (196 x 40 mm) SW: 8.78 x 2.34 in. (223 x 59,5 mm)	5.24 x 0.98 in. (133 x 25 mm)	5.24 x 0.98 in. (133 x 25 mm)
Weight (without cable)	Approx. 1.46 lb (660 g) SW: approx. 2.58 lb (1.170 g)	Ca. 660 g; SW: ca. 860 g	Approx. 0.77 lb (350 g)	Approx. 0.66 lb (300 g)
Guaranty	2 years for defects of quality	2 years for defects of quality	2 years for defects of quality	2 years for defects of quality

Technical Data Conductivity Cells for Special Purposes

Model	TetraCon® 325	TetraCon® DU/T	LR 325/01	LR 325/001
Sensor Type	4-electrode cell	4-electrode cell	2-electrode cell	2-electrode cell
Electrode	Carbon	Carbon	316 Ti stainless steel	316 Ti stainless steel
Measuring Range	1 µS/cm … 2 S/cm	1 µS/cm … 2 S/cm	0.001 µS/cm … 200 µS/cm	0.0001 µS/cm … 30 µS/cm
Cell Constant	K=0.475 cm^{-1}	K=0.778 cm^{-1}	K=0.1 cm^{-1}	K=0.01 cm^{-1}
Temperature Sensor	Integrated	Integrated	Integrated	Integrated
Flow-thru Measurement	Yes, with additional flow chamber D 201	yes	Yes, with additional flow chamber D01/T	Yes, with integrated flow chamber
Length / Diameter	4.72 in. (120 mm)/ 0.62 in. (15.7 mm)	6.10 in. (155 mm)/ 0.39 in. (10 mm)	4.72 in. (120 mm)/ 0.47 in. (12 mm)	4.72 in. (120 mm)/ 0.79 in. (20 mm)
Guaranty	2 years for defects of quality	2 years for defects of quality	2 years for defects of quality	2 years for defects of quality

Ordering Information

Digital Conductivity Cells		**Order No.**
TetraCon® 700 IQ	Submersible conductivity sensor for water/wastewater	302 500
SACIQ-7,0	Sensor connection cable for all IQ sensors, cable length 23 ft. (7.0 m)	480 042
Analog Conductivity Cells		**Order No.**
TetraCon® 700-7	Submersible conductivity sensor for water/wastewater, cable length 23 ft. (7.0 m)	302 316
LRD 01-7	Submersible conductivity sensor for boiler feed water/ion exchanger, cable length 23 ft. (7.0 m)	302 222
LRD 325-7	Submersible conductivity sensor for water/wastewater, cable length 23 ft. (7.0 m)	302 229

Digital:
IP 68 CE 2 Year Guaranty

Analog:
IP 68 CE 2 Year Guaranty

Further cable length and special seawater/brackwater designs and accessories see brochure "Product Details"

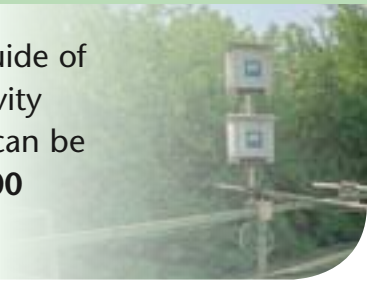
** useable with monitor 170/296: up to 200 mS/cm*
*** SW: Sensor in sea water design (with plastic armouring (POM))*

Configuration Guide digital conductivity measurement

		1. Measuring range 2. Cell constant 3. Probe type 4. Temperature compensation	5. Temperature range 6. Pressure range 7. Protection rating	IQ Sensor Net Systems 2020 XT/182
Digital	**TetraCon® 700 IQ**	1.: 10 µS/cm ... 500 mS/cm 2.: K=0.917 cm^{-1} 3.: 4-electrode cell 4.: NTC	5.: 32 ... 140 °F (0 ... 60 °C) 6.: 10 bar 7.: IP 68 (electrode)	Water/Wastewater; Usable Measuring Range: 0.00 ... 20.00 µS/cm 0.0 ... 200.0 µS/cm 0.000 ... 2.000 mS/cm 0.00 ... 20.00 mS/cm 0.0 ... 200.0 mS/cm 0 ... 500 mS/cm
Analog				Junction box for connecting the analog measuring cells to the IQ Sensor Net:
	TetraCon® 700	1.: 10 µS/cm ... 1000 mS/cm 2.: K=0.917 cm^{-1} 3.: 4-electrode cell 4.: NTC	5.: 32 ... 122 °F (0 ... 50 °C) 6.: 10 bar 7.: IP 68 (electrode)	KI/LF-0,9/MIQ 505 570
	LRD 01	1.: 0,01 ... 200 µS/cm 2.: K=0.1 cm^{-1} 3.: 2-electrode cell 4.: NTC	5.: 32 ... 266 °F (0 ... 130 °C) 6.:14 bar (68 °F/20 °C) 7.: IP 68 (electrode)	KI/LF-0,1 MIQ 505 573
	LRD 325	1.: 1 µS/cm ... 2 S/cm 2.: K=0.475 cm^{-1} 3.: 4-electrode cell 4.: NTC	5.: 32 ... 212 °F (0 ... 100 °C) 6.: 10 bar 7.: IP 68 (electrode)	KI/LF-0,4/MIQ 505 572
	LR 325/01	1.: 0.001 ... 300 µS/cm 2.: K=0.1 cm^{-1} 3.: 2-electrode cell 4.: NTC	5.: 32 ... 212 °F (0 ... 100 °C) 6.: 2 bar 7.: IP 68 (electrode)	KI/LF-0,1 MIQ 505 573 + ADA/AMPH-LAB-LF 303 212
	LR 325/001	1.: 0.0001 ... 30 µS/cm 2.: K=0.01 cm^{-1} 3.: 2-electrode cell 4.: NTC	5.: 32 ... 212 °F (0 ... 100 °C) 6.: 2 bar 7.: IP 68 (electrode)	KI/LF-0,01 MIQ 505 574 + ADA/AMPH-LAB-LF 303 212
	TetraCon® 325	1.: 1 µS/cm ... 2 S/cm 2.: K=0.475 cm^{-1} 3.: 4-electrode cell 4.: NTC	5.: 32 ... 212 °F (0 ... 100 °C) 6.: 2 bar 7.: IP 68 (electrode)	KI/LF-0,4/MIQ 505 572 + ADA/AMPH-LAB-LF 303 212
	TetraCon® DU/T	1.: 1 µS/cm ... 2 S/cm 2.: K=0.778 cm^{-1} 3.: 4-electrode cell 4.: NTC	5.: 32 ... 140 °F (0 ... 60 °C) 6.: 2 bar 7.: IP 65	KI/LF-0,7/MIQ 505 571 + ADA/AMPH-LAB-LF 303 212 + KKDU 325 301 963

— Not Applicable

Analog conductivity measurement



Configuration guide of analog conductivity measuring cells can be seen on **page 100**